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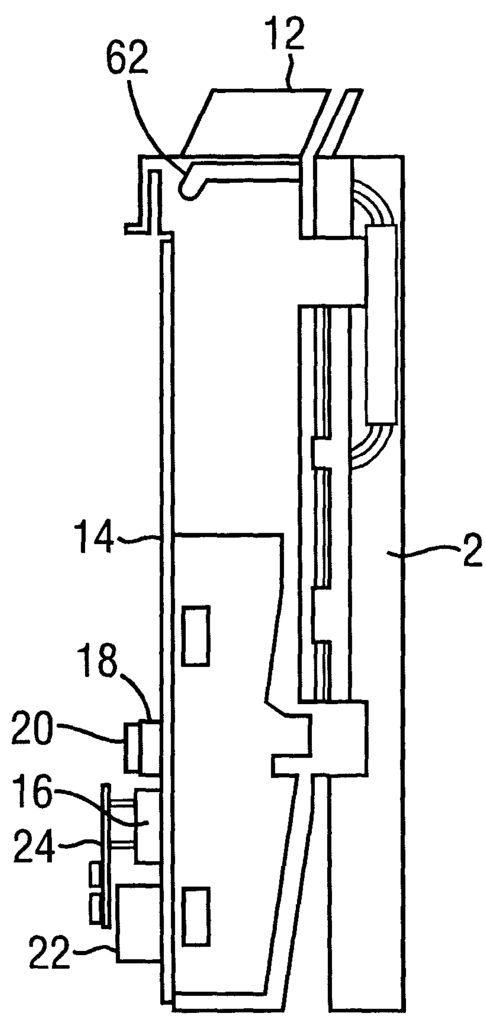
(54) **Coin validation apparatus**

(57) In order to enhance old coin validators intended for obsolete PROM data is stored in a non-volatile electrically programmable read only memory device mounted in a subsidiary assembly and interfaced to pins positioned in the subsidiary assembly to engage an integrated circuit socket mounted on the main circuit board so as to provide the data to the signal processor, the subsidiary assembly also having means to select whether the electronically programmable read only memory is in read mode or write mode.

Older validation units may not have the processing discrimination performance to securely recognise newer designs of coins, particularly concentric bi-metallic coins such as the GB 2 pound and the 1 & 2 Euro coins. A second circuit board is connected to receive sensor signals; from the original board. A second signal processor receives and evaluates the sensor signals and stored data representing limits of the sensor signals corresponding to one or more valid coins, to provide one or more validation signals indicative that a respective coin has been validated.

A cradle is fitted in place of an old coin validator. The cradle carries a new coin validator having a relatively small width and providing a second set of output coin validation signals. The new cradle positions the new coin validator so that coin slots and a coin return button are placed correctly in relation to the change giver and carries an interface to convert the first set of coin validation signals to the second set. Otherwise obsolete apparatus can us be rejuvenated by fitting a normally incompatible "new" coin validator.

FIG. 3



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Description

[0001] This invention relates to the field of electronic coin recognition or "validation".

[0002] There are many millions of existing "unattended points of sale" in use throughout Europe and the rest of the world. These machines are used in vending, gaming, ticket dispensing and pay telephone applications, for example. Whenever a coin type is changed or a new coin added, these unattended points of sale need to be changed as well.

[0003] In general, data representing limits of parameters of valid coins are stored and parameters measured for a coin being tested are compared with these to validate or reject a coin. Older coin validators, had this data stored in non erasable programmable read only memory (PROM). Each time a change was necessary a new PROM was burnt. In order to be replaceable the PROMS were mounted in integrated circuit sockets, e.g. dual in line (DIL) sockets. It was necessary to burn the new PROM individually for its intended validator because of the differences due to mechanical and electrical tolerances in each individual validator. A problem has arisen recently, however. The PROMs are obsolete and existing stocks are, naturally, dwindling thereby increasing in value due to scarcity. They will, eventually, run out. That would make the validators obsolete when the next coin change occurs.

[0004] Against this background, a coin validator in accordance with one aspect of the invention has magnetic and/or optical sensors operative to provide sensor signals determined by particular characteristics of a coin to be validated; a main circuit board containing drivers for providing driver signals to operate the sensors and a signal processor to receive the sensor signals and stored data representing limits of the sensor signals corresponding to one or more valid coins, to provide one or more validation signals indicative that a respective coin has been validated, the data being stored in a non-volatile electrically re-programmable read only memory device mounted in a subsidiary assembly and interfaced to pins positioned in the subsidiary assembly to engage an integrated circuit socket mounted on the main circuit board so as to provide the data to the signal processor, the subsidiary assembly also having means to select whether the electrically re-programmable read only memory is in read mode or write mode.

[0005] This enables an "old" validator, designed for use with a PROM, to be rejuvenated with a readily available electrically re-programmable read only memory (EEPROM). Once the replacement has been made, future changes, which may have to be made in the field anyway, can be made without the need for further replacement.

[0006] Although, by using a new PROM or by replacement with the EEPROM, in many cases the coin validation parameters can be simply re-programmed, older validation units may not have the processing discrimination performance to securely recognise newer designs of coins, particularly plated coins and concentric bi-metallic coins such as the GB 2 pound and the 1 & 2 Euro coins.

[0007] One solution to that problem is to replace the entire circuit board of a coin validator with a new one conforming to the required standards. However, a second aspect of the invention is based on the realisation that this is not necessary.

[0008] In accordance with the second aspect of the invention, there is provided a coin validator, having magnetic and/or optical sensors operative to provide sensor signals determined by particular characteristics of a coin to be validated; a first circuit board containing drivers for providing driver signals to operate the sensors, a first signal processor for receiving and evaluating the sensor signals and stored data representing limits of the sensor signals corresponding to one or more valid coins, to provide one or more first validation signals indicative that a respective coin has been validated, a second circuit board connected to the first circuit board to receive the sensor signals; and a second signal processor to receive and evaluate the sensor signals and stored data representing limits of the sensor signals corresponding to one or more valid coins, to provide one or more second validation signals indicative that a respective coin has been validated.

[0009] This enables the performance of a validator to be enhanced without replacing the whole circuit board, since the drivers from the old board are still used.

[0010] Preferably, the second circuit board includes means for receiving the first validation signals and the second validation signals said means being operative selectively to switch the first or second validation signals to an output connector. This enables the new board to be fitted in advance and the validator can continue to run on the old board only, until such time as, say, the 1 and 2 Euro coins become legal tender.

[0011] Another way of improving performance would be to replace a complete older coin validator with an up to date version. Again, in older apparatus at unattended points of sale, e.g. using change givers this proposal would often cause a problem. Such older apparatus was designed to be used with a validator of particular physical dimensions and to receive a particular set of validation signals. More recently there has been a change in the physical dimensions, newer validators are narrower, and have an incompatible signal set. The desire to upgrade the validator of such an older apparatus giver would thus render the entire apparatus obsolete.

[0012] In accordance with a third aspect of the invention, there is provided apparatus intended for use with a first coin validator having a relatively large width and providing a first set of output coin validation signals, said apparatus being fitted with a cradle in place of the first coin validator, said cradle carrying a second coin validator having a relatively small width and providing a second set of output coin validation signals, said cradle positioning the second coin validator so that coin slots and a coin return button are placed correctly in relation to the apparatus and carrying an interface to convert the first set of coin validation signals to the second set. Otherwise obsolete apparatus can thus be rejuvenated by fitting a higher performance normally incompatible "new" coin validator.

[0013] Examples of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 illustrates the main components of a coin change giver;
Figure 2 illustrates a circuit board utilised in a first embodiment of the first aspect of the invention;
Figure 3 illustrates the circuit board of Figure 2 in position on the first embodiment of the first aspect of the invention;
Figure 4 illustrates another circuit board utilised in a second embodiment of the first aspect of the invention;
Figure 5 is a scrap view of the second embodiment of the first aspect of the invention;
Figure 6 is a block diagram of the circuit on the circuit boards illustrated in Figures 2 and 4;
Figure 7 illustrates a circuit board utilised in an embodiment of the second aspect of the invention;
Figure 8 is a block diagram of the circuit of the board of Figure 7; and
Figure 9 illustrates physical features of the board of Figure 7;
Figure 9a is a scrap section on arrows A-A of Figure 9 and
Figure 10 illustrates a coin validator and carrier utilised in an embodiment of the third aspect of the invention.

[0014] As an example, the enhancement of a typical coin change giver as used in many millions of vending machines is described.

[0015] Figure 1 illustrates the main components of a coin change giver. A coin validator 2 is used to recognise a valid coin, which is then routed to either a cashbox of the machine (not shown), or to replenish change tubes 4 via a separator 6. The change tubes 4 are used to give the consumer change at the end of the vending transaction. The coin validator 2, change tubes 4 and separator 6 are mounted in a chassis 8 together with a control board 10, a power supply (not shown)and interfaces to the remainder of the vending machine (not shown).

[0016] The coin validator 2 represents only a proportion of the overall cost of the change-giver. It is clearly advantageous to the vending machine owner to be able to minimise the cost of changing their machine to operate with a new coin or coins.

[0017] There are many descriptions of prior art showing the methods used for coin validation, which may include inductive or optical sensors for detecting the size, shape and material of a coin. A detailed example of this is disclosed in US patent number 4601380. Validators of design similar to this and other patent descriptions have been used widely throughout the world for many years.

[0018] The coin validator 2 has a slot or chute 12 for receiving coins to be validated. Coins pass down a slope past sensors which may be magnetic or magnetic and optical. The sensors provide sensor signals dependent on characteristics such as the thickness, diameter and electrical conductivity of the coin. The sensor signals are processed by a processor carried by a circuit board 14. This also carries drivers for each of the sensors and one or more integrated circuit sockets 16, 18 intended to receive a PROM containing data defining the limits of the characteristics represented by the sensor signals. A PROM 20 is shown in the socket 18.

[0019] In the past, when a coin change was made, the data relevant to the changed coin set was burned into a new PROM. This was often done in the field using a set of specimen coins so as to take into account the electrical and mechanical tolerances of the individual coin validator. To this end, the sensor signals are available at a connector 22 mounted on the board 14.

[0020] The PROMs are now obsolete and in short supply. The impending introduction of the Euro coins implies all coin validators will need to be updated throughout the Euro zone.

[0021] In order to overcome this problem a replacement memory assembly 24 is illustrated in the socket 16. This is shown in more detail in Figure 2. The PROM is substituted by an electrically re-programmable read only memory component, in this example an integrated circuit 26. In the example illustrated the integrated circuit (IC) 26 is a surface mount component and is also electrically erasable. The IC 26 is mounted on a circuit board 28 with a set of pins 29 arranged to fit the socket 16. In the case illustrated there are 16 pins 29. For safety, the board may be secured removably to the connector 22 which it overlaps. The board 24 also carries a jumper, switch or further connector 30 by which the memory IC 26 can be set to read or write mode. Another jumper switch or connector 31 allows different coin sets to be selected, e.g. French coins and alternatively Euro coins.

[0022] Referring to Figure 6, the address and data pins of the memory IC 26 are connected on the board 28 to appropriate pins 29 along with the chip select pin CS and supply voltages.

[0023] The memory IC's write enable pin $\overline{WR}$ and read enable pin $\overline{OE}$, are alternatively selected by operation of a switch SW1. A pull up resistor R1 connects the input of an invertor 33 to the supply rail +ve. The output of the invertor 30 is coupled to the read enable pin $\overline{OE}$ and to the input of another writer 35 the output of which is connected to the write enable pin $\overline{WR}$.

[0024] Thus closing the switch S1 enables the memory IC 26 to be written and opening the switch enables the memory to be read.

[0025] The memory component may be any non-volatile type such as an EPROM, FLASH or EEPROM type.

[0026] An alternative arrangement of the memory assembly is illustrated in Figures 4 and 5. Validators for some games machines have a casing 32 in which an aperture 34 is provided to give access to the PROM so that it can be replaced in the socket 16. The size of the aperture 34 is sufficient to replace the PROM but there is not a great surplus. I have found there is sufficient space to receive a memory assembly arranged as shown in Figure 4. Here the width is narrow enough to be received by the available aperture. As illustrated in Figure 5, the memory 26 end of the board can be inserted at an angle under the case so as to align the pins 29 with the socket 16 into which the pins are then inserted. SW1 is in the form of pins to receive a jumper in this example.

[0027] Figure 7(a) shows the connections between the coin validator 2 and the control board 10. Figure 7 (b) shows the connection of an additional circuit board to provide processing for enhanced coin discrimination.

[0028] Figure 8 shows a block diagram of the circuitry on the additional circuit board (7). As may be seen from Figure 9, the additional board 36 has a connector 38 by which it receives the sensor signals available at the connector 16. The sensors are operated by the drivers on the board 14. The sensor signals received by the connector 38 are processed by a gate array 40 whose function is explained below. The processed signals are fed to data inputs of a signal processor in the form of a micro controller 42. The data representing limits for the sensor signals to correspond to one of a set of coins is stored in an EEPROM 44. These data are accessed by the controller 42 to evaluate the validity of a the coin sensed by the sensors. Outputs 46 on individual leads indicate which, if any, coin has been validly sensed. Alternatively the outputs may be coded, e.g. a binary code. These are input to a mulitplexer 50 with the equivalent signals 48 from the "old" board 10. A manually settable select signal determines which input the multiplexer selects. The select signal is also input to a select chip input of the controller 42 so that when the signals from the processor 42 are selected, it is operative.

[0029] The select input may be provided by either a switch, or a "jumper". The "old" board 14 can thus be used, for example, until a new coin set becomes legal tender when the additional board 36 with the enhanced discrimination performance can be selected. When selecting the original coin set the signals to and from the validator 2 are routed directly through the additional board. When selecting the new coin set with enhanced discrimination, the coin outputs 50 and an ACCEPT strobe signal come from the micro-controller 42.

[0030] The additional board 36 takes measurements directly from the sensor signals rather than from the processed coin outputs from the existing validation board. These signals often oscillator or optical detector outputs, are used for the factory or field programming of the validator. Through measuring the sensors directly, with the aid of the logic in the gate array 40, the micro-controller 42 is able to apply signal processing to the sensor responses to a performance similar to state of the art coin validators, rather than the level applied by the older design within the original validator. Specifically in this example, the gate array 40 makes time period, frequency and amplitude measurements permitting additional parameters to be extracted from the diameter sensor, the thickness sensor and the material sensors to improve the validation of concentric bi-metallic coins, such as the GB 2 pound coin. The programme in the micro-controller 42 takes these measurements and processes the variations in frequency or time period to extract the coin parameters which are then compared with the expected responses of valid coins programmed into the non-volatile memory 44 on the additional board 36. A serial port 52 is provided into the micro-controller 42 to permit programming of the set of coins to be recognised, and any future re-programming as the coins change.

[0031] The described techniques are equally applicable to coin discriminators and change-givers manufactured by different companies.

[0032] For change-givers as illustrated in Figure 1 and, indeed other apparatus utilising the older coin validators, an alternative means of enhancing the discrimination performance is the complete replacement of the validator 2 with a state of the art commercially available validator 56 shown in Figure 10. To provide compatibility with the original validator electrically and mechanically, a cradle 58 and an interface circuit 60 are used. Typically old validators 2 are approximately 5 inches (125mm) wide whereas the current state of the art validators are approximately 4 inches (100mm) wide and use different fixing systems. In order to mount the cradle in an "old" change giver or other apparatus, the cradle is provided with hooked rails 62 one on each side. (only one is shown in Figure 10.) These are hooked onto pins projecting into the cavity 64 (Figure 1) intended to receive the validator 2. As the bottom of the cradle 58 is swung in, latches engage apertures 66 on each side of the cradle, only one being shown in Figure 10. In the case illustrated, the new validator 56 has four pins 68 projecting from its casing, two on each side. Only one is visible in Figure 10. The cradle 58 provides a cavity 70 having a width suitable to receive the new coin validator 56. Opposed walls of the cavity 70 have hooked channels 74 to receive the pins 68. The down turned hook 76 in each channel receives the respective pin to retain the validator 56 in the cradle. In order to function correctly, the new validator 56 must have its inlet coin slot 12, its outlet coin slot (not shown) and its coin return button 78 located relative to one another to match the relative locations of these elements of the old validator 2. The cavity 70 of the cradle 58 must position the features to match the "old" change giver or other apparatus.

[0033] The "old" change giver is designed to receive active high signals on one of six lines, individual to a respective coin. Thus to validate a coin a corresponding line goes high to identify the coin. The active-high signal is accompanied by a validation strobe or pulse signal. Generally, the "new" validators have active low outputs, again on six lines, but there is no validation stroke signal. The signals may, again, be on an individual line for a respective coin, or may be coded. The cradle 58 carries an interface 78 which receives the active low signals from the validator 56 and decodes them if necessary and produces active high signals at six pins of a connector 80. A validation strobe signal is also produced to accompany each coin identifying single line output signal.

[0034] The change tubes 4 may also require adaptation to the new coin types through the widely used technique of inserting a sleeve into the tubes for smaller coin diameters.

[0035] The described techniques are equally applicable to coin discriminators and change-givers manufactured by many different companies.

Claims

1. A coin validator, having magnetic and/or optical sensors operative to provide sensor signals determined by particular characteristics of a coin to be validated; a main circuit board containing drivers for providing driver signals to operate the sensors and a signal processor to receive the sensor signals and stored data representing limits of the sensor signals corresponding to one or more valid coins, to provide one or more validation signals indicative that a respective coin has been validated, the data being stored in a non-volatile electrically re-programmable read only memory device mounted in a subsidiary assembly and interfaced to pins positioned in the subsidiary assembly to engage an integrated circuit socket mounted on the main circuit board so as to provide the data to the signal processor, the subsidiary assembly also having means to select whether the electronically re-programmable read only memory is in read mode or write mode.

2. A coin validator as claimed in claim 1 wherein the subsidiary assembly includes means to select data for different coin sets.

3. A coin validator as claimed in claim 1 or 2, wherein the means to select read or write mode and/or to select different coin sets are a respective manually operable switch or jumper.

4. A coin validator, having magnetic and/or optical sensors operative to provide sensor signals determined by particular characteristics of a coin to be validated; a first circuit board containing drivers for providing driver signals to operate the sensors, a first signal processor for receiving and evaluating the sensor signals and stored data representing limits of the sensor signals corresponding to one or more valid coins, to provide one or more first validation signals indicative that a respective coin has been validated, a second circuit board connected to the first circuit board to receive the sensor signals; and a second signal processor to receive and evaluate the sensor signals and stored data representing limits of the sensor signals corresponding to one or more valid coins, to provide one or more second validation signals indicative that a respective coin has been validated.

5. A coin validator as claimed in claim 4, wherein the first circuit board bears a first connector providing access to the sensor signals for calibration in order to write the stored data; and wherein the second circuit board bears a second connector, connected to the first connector, in order to receive the sensor signals.

6. A coin validator as claimed in claim 3, wherein the second circuit board includes means for receiving the first validation signals and the second validation signals said means being operative selectively to switch the first or second validation signals to an output connector.

7. A coin validator as claimed in claim 3 or claim 4, wherein the first circuit board carries a non-erasable programmable read only memory containing the data for the first processor.

8. A coin validator as claimed in any of claims 4 to 7, wherein the second processor is arranged to determine from the sensor signals coin characteristics additional to those which the first process is arranged to determine.

9. Apparatus intended for use with a first coin validator having a relatively large width and providing a first set of output coin validation signals, said apparatus being fitted with a cradle in place of the first coin validator, said cradle carrying a second coin validator having a relatively small width and providing a second set of output coin validation signals, said cradle positioning the second coin validator so that coin slots and a coin return button are placed correctly in relation to the apparatus and carrying an interface to convert the first set of coin validation signals to the second set.

FIG. 1

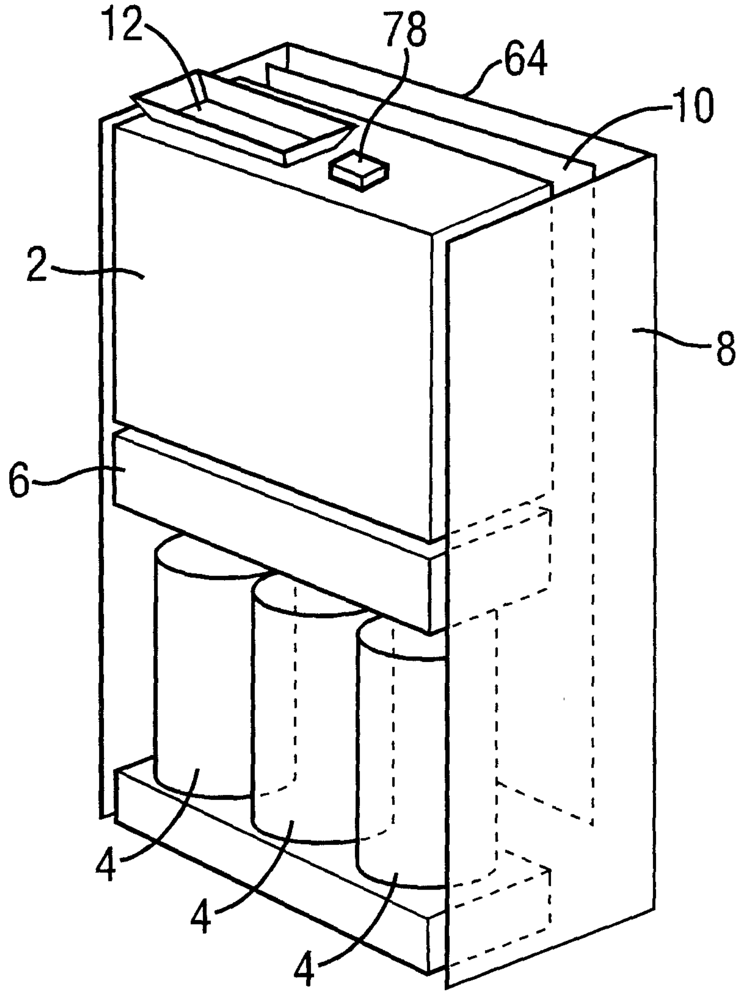
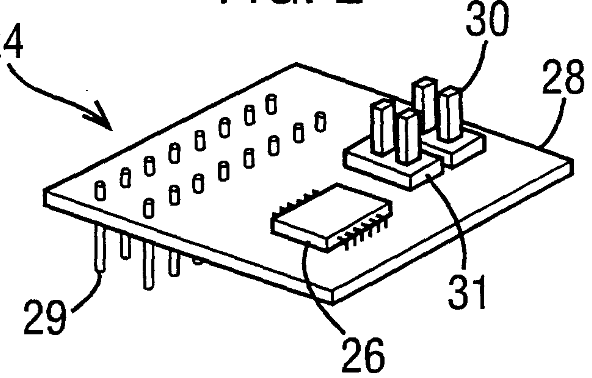


FIG. 2



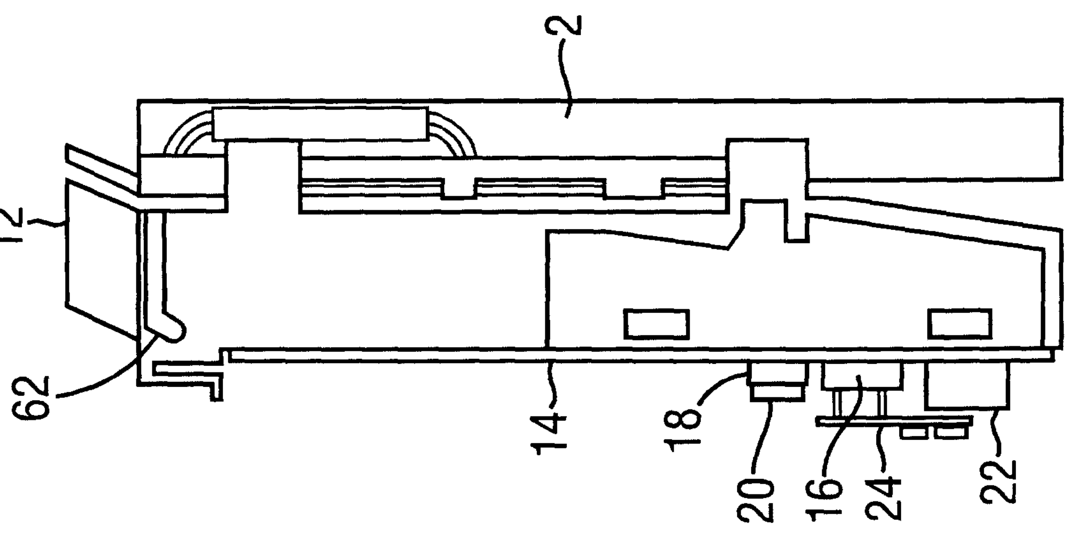


FIG. 3

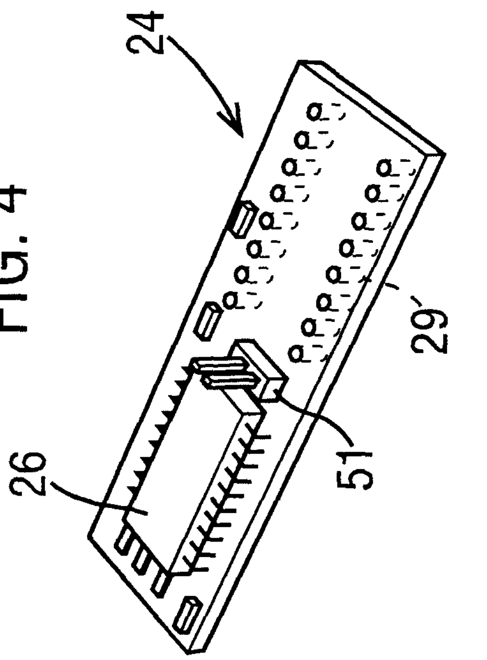


FIG. 4

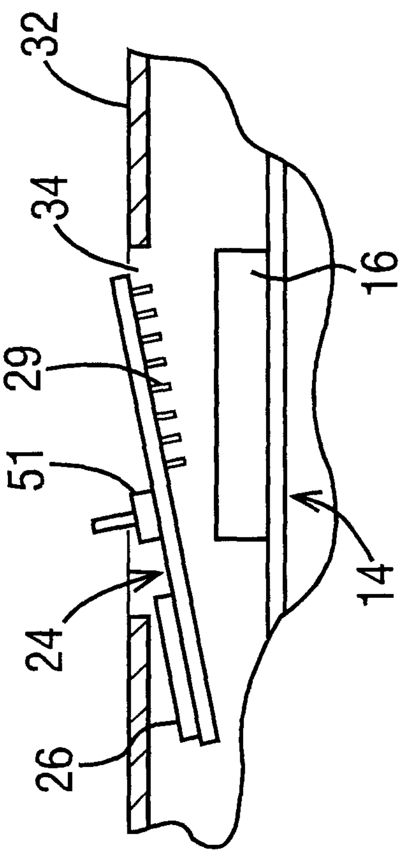


FIG. 5

FIG. 6

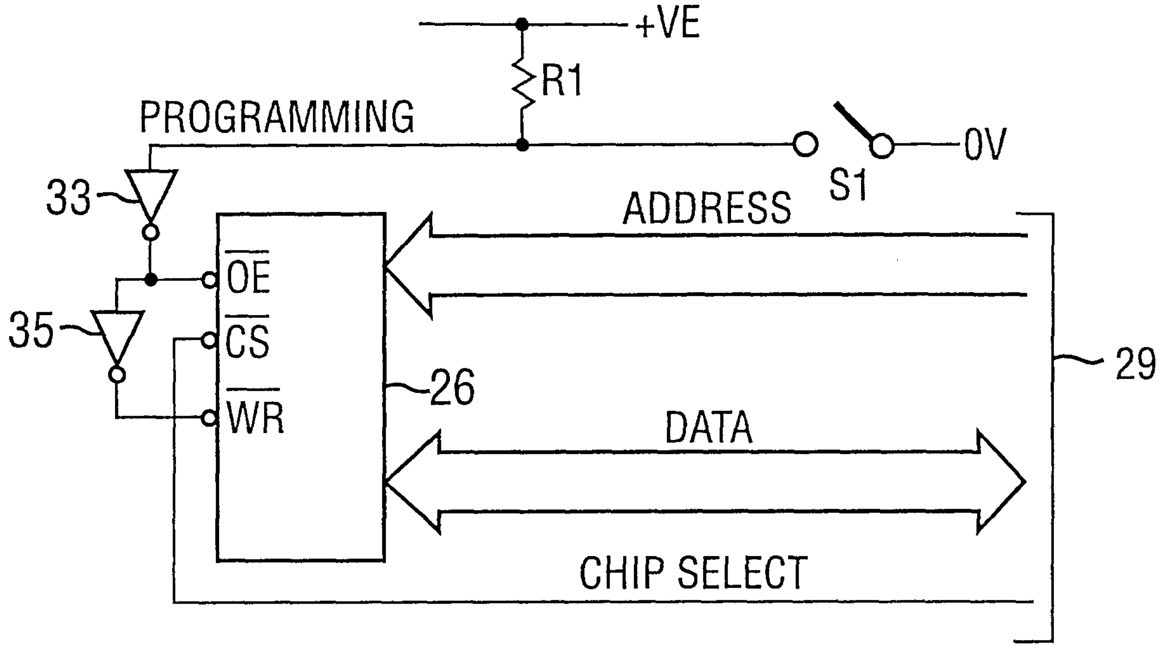


FIG. 7a

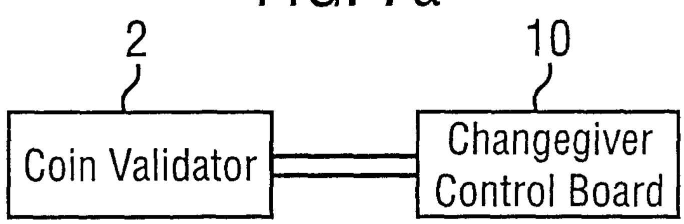
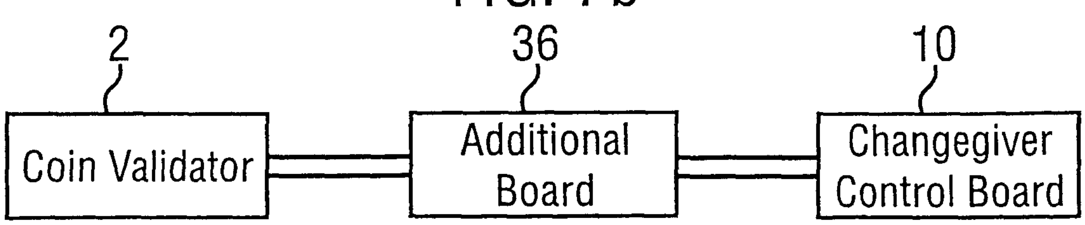


FIG. 7b



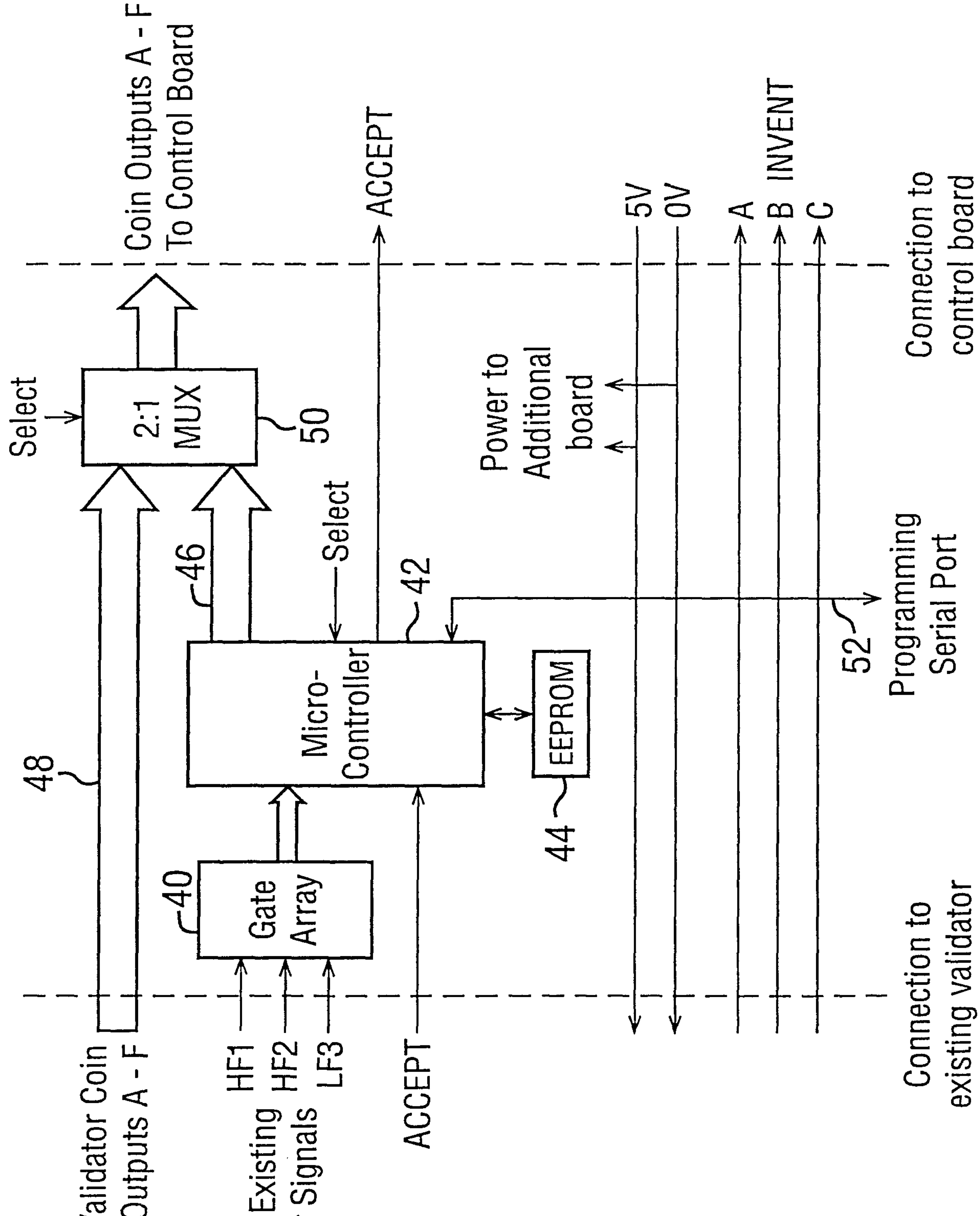

Validator Coin Outputs A - F
Existing Sensor Signals
HF1
HF2
LF3
ACCEPT
48
40
Gate Array
Micro-Controller
44
EEPROM
42
46
Select
50
2:1 MUX
Select
Coin Outputs A - F To Control Board
ACCEPT
Power to Additional board
Programming Serial Port
52
5V
0V
A
B INVENT
C
Connection to existing validator
Connection to control board

FIG. 8

FIG. 9

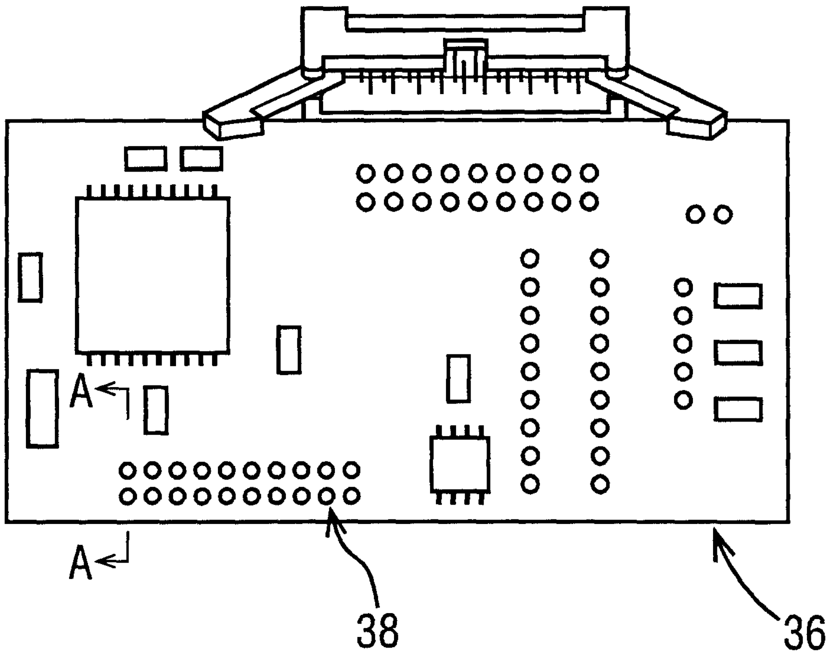


FIG. 9A

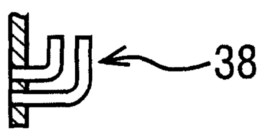


FIG. 10